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AN EASY AND VERY PRACTICABLE METHOD TO ENABLE DEAF PERSONS TO HEAR:

Together with
A brief Account of, and ſome Reflections and Obſervations upon, the ſeveral Attempts formerly made for the Benefit of ſuch Perſons.

Tranſlated from the GERMAN
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MVSEVM
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INTRODUCTION.

THE more extenſively uſeful, and the more adapted to the occaſions of life, the matters are which an author takes upon him to lay before his readers, the more he anſwers that end, which every virtuous man ought, in juſtice, to propoſe to himſelf in every addreſs to the Public, and the more ſuch matters claim the attention and patience of the reader. Theſe conſiderations have princi-

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pally weighed with me in favour of the preſent undertaking, and I promiſe myſelf, on this occaſion, the approbation of every one, who can put a due value on the enjoyment of his ſenſes, as well as of him, who can be ſenſible of the great diſadvantage ariſing from the loſs of any of them.

Sight and hearing are undoubtedly two of the principal external ſenſes, as they ſupply us with the knowledge of a far greater number of external objects, than the other ſenſes put together; which, though indeed of conſiderable, are yet of a more limited uſefulneſs, and their impairment or loſs more tolerable; but blind or deaf, what melancholy objects! Both blind and deaf, what accumulated woe!

I wave, at preſent, the ſeveral attempts wich have been made, in order to correct the manifold defects of ſight, at leaſt to leſſen or render them tolerable, confining my reflections, on this occaſion, to that of hearing; and, for that purpoſe I ſhall relate the ſeveral means deviſed, in order to amend this ſenſe, when impaired, or retrieve it, when intirely loſt; or by help of the other ſenſes, and a tolerable degree of underſtanding in the patient, to render its loſs, in ſome meaſure, more tolerable: And laſtly, I ſhall ſelect, among the ſeveral methods propoſed, that, which to me appears, to be the eaſieſt and moſt ſimple. But, previous to this, I ſhall briefly explain the reaſons of the principal defects of the ſenſe of hearing, both from their cauſes, and from the ſtructure of the outer and inner ear; and then more accurately determine the greater or leſs utility of the methods hitherto employed, in order to amend theſe defects.

AN
EASY AND PRACTICABLE
METHOD, &c.

CHAP. I.

Containing reflections preparatory to the following diſcourſe.

AMONG the defects, to which the ſenſe of hearing is ſubject, the greateſt, without diſpute, is the entire loſs thereof, or that, which, in a word, we call *deafneſs*. This, when either brought into the world, or contracted before a child comes to the uſe of his underſtanding, and before he learns to ſpeak, renders him very unhappy, as thereby he continues to be ſpeechleſs or dumb, and

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thus precluded all ſocial intercourſe. And this is the reaſon, why perſons born deaf, are at the ſame time alſo dumb, if not taught to ſpeak by ſome peculiar devices, or by means of the other ſenſes. To this defect of hearing, we are to claſs that which is called *difficulty of hearing*; which, beſides that it comes neareſt to abſolute deafneſs, proceeds, for the moſt part, from the ſame cauſes, only in a leſs degree; all the other defects of this ſenſe, as not being to our preſent purpoſe, we ſhall wave at this time.

All the ſenſes have from nature their proper organs, which are in a certain determinate manner affected and altered by external objects; and firſt, in that they propagate theſe affections or alterations to the *common ſenſory*, and thereby render our ſenſations complete, and communicate them to the ſoul. Now, as deafneſs is the inability to perceive thoſe tremulous or vibratory motions of the air, which produce ſound; the cauſe of this defect muſt neceſſarily be, either in the organ itſelf, namely the ear, or in its connection with the common ſenſory, the vibrations of the air being prevented from producing the neceſſary and determinate alterations in thoſe parts of the human body. The ſame thing holds with reſpect to difficulty of hearing, as being only a leſs degreee of deafneſs.

The ear conſiſts of ſeveral diſtinct parts, which together concur to produce the ſenſe of hearing. Hence, if the cauſes of deafneſs, or of a difficulty of hearing, are in the ear itſelf, one or more parts thereof muſt be injured, that is, be in a preternatural ſtate. To ſhew this the more diſtinctly, it is neceſſary to conſider thoſe parts ſeparately, and to explain the preternatural alterations which occaſion deafneſs, or a difficulty of hearing.

Anatomiſts commonly divide the parts of the ear into two ſorts, namely, thoſe which belong to the external ear, and are ſituate without the temporal bones; and into thoſe that conſtitute the inner ear, compriſing all the parts that lie within the ſaid bones.

To the firſt ſort belongs that which is properly called the outer ear, and the *meatus auditorius*, or auditory paſſage or canal, the inner part of which laſt, anatomiſts generally refer to the inner ear; but it may be here very commodiouſly treated, together with the external parts, as being only a paſſage from them. As the different defects of that which is properly called the external ear, if, in other reſpects, the aperture of the auditory paſſage is not at the ſame time affected, may produce a difficulty of hearing, or other defect of this ſenſe, but are never the cauſes of perfect deafneſs; ſo I ſhall not inſiſt on this, but directly handle the ſeveral defects of the auditory paſſage, as an external part of the ear, ſo far as they are to my preſent purpoſe.

The uſe of the auditory paſſage is, to propagate the vibrations of the air, communicated externally thereto, by repeated repercuſſions in its cavity, to the inner parts of the ear: And thence it is neceſſary, that this paſſage be neither obſtructed, nor extraordinarily conſtricted or ſtraitened. In the firſt caſe, deafneſs is the conſequence; in the laſt, a difficulty of hearing at leaſt. The firſt defect often ariſes either from a long accumulated, a condenſed, or a greatly indurated ear-wax, or from foreign bodies introduced into the auditory paſſage; as for inſtance, cherry-ſtones, peas, lead-ſhot, &c. or from tumours and impoſthumes, or from fleſhy or ſpungy excreſcences therein; or, very often from the concretion of its ſides from ſuch impoſthumes; or, laſtly, from a pellicle or membrance growing acroſs it, as is frequently obſerved in new-born children. The other defect of the auditory paſſage, namely, its too great conſtriction, may ariſe from the very ſame cauſes, if we only except the preternatural membrane ſtretched acroſs it, or the obſtruction of the auditory paſſage by fluid matters, which diffuſe themſelves on every ſide.

The ſecond ſpecies of the parts of the ear, mentioned above, conſtitutes the inner ear, and compriſes the membrane of the *tympanum*, or drum, its cavity, the labyrinth, the *tuba Euſtachii*, and the auditory nerves. The membrane of the drum receives by the auditory paſſage the tremulous motions or vibrations of the air, which it farther diffuſes in its cavity, and in the labyrinth. But particularly in the drum we find four ſpecies of defects, which prevent its ordinary uſe: One, the too great flaccidity of its membrane, whereby it is unfitted for vibrations or tremulous motions, and ſo tranſmits ſounds, either not at all, or but faintly, to the other inner parts. And hence we may judge, how it happens, that a phlegmatic conſtitution, moiſt and purulent ears, damp air, foggy and rainy weather, and the like, often increaſe a difficulty of hearing, to a pitch of perfect deafneſs. The other defect of the membrane of the drum is directly oppoſite to this, and conſiſts in an extraordinary tenſion thereof; which, when to ſo conſiderable a degree, as too much to reſiſt the inſinuating tremulous air, and prevent its vibrations, gives riſe in like manner to a difficulty of hearing, and even to perfect deafneſs; as may be often obſerved in the caſe of elderly people, and emaciated conſtitutions. Both theſe defects, flaccidity and tenſion, may alſo ariſe from an undue action of the muſcles, moving the ſmall auditory bones. But as ſuch conſiderations would carry us to anatomical

tomical and philoſophical niceties, we ſhall wave them at preſent, as not greatly to our purpoſe. The complete induration, or even oſſification of the membrane of the drum, is the third defect; which may beſides, from the ſame cauſes mentioned before, under the extraordinary tenſion of this membrane, impair the hearing. And laſtly, its laceration conſtitutes the fourth defect, which, indeed, does not ſo ſoon vitiate the hearing; as the air, inſinuating into the auditory paſſage, can freely paſs into the inner parts of the ear, and put them in motion: but then, by this immediate contact, the juſt mentioned tender and ſenſible inner parts are blunted and rendered unfit for farther regular ſenſations.

The cavity of the drum, and the labyrinth are, indeed, as conſiſting of bones of a more durable ſubſtance than all the parts of the ear hitherto mentioned, ſometimes, however, ſubject to ſeveral untoward accidents, whereby the hearing may be injured or depraved. For as they are covered with a very tender and extremely ſenſible *perioſteum*, which may be affected with inflammation and impoſthume, and thereby be either deſtroyed, or ſo indurated, that no communicated vibrations of the air can any longer put them in due motion: Or, alſo, as theſe cavities are ſometimes ſo choaked up with purulent matter, as to become unfit for propagating the vibratory motions of the air; or that at length there ſometimes enſues from the impoſthumation of the *perioſteum*, a caries of the bones themſelves, which may intirely deſtroy the whole of this curious piece of mechaniſm, and unfit it for its deſtination.

In the laſt place, before I touch on the defects of the auditory nerve, I muſt farther mention the *tuba Euſtachii*, which ſome reckon among the parts of the external ear, but which I refer to the internal, becauſe the bony part of this paſſage lies between the temporal bone and the *os multiforme*; beſides, the entire paſſage lies concealed in the cavity of the mouth: And running from the cavity of the drum to the palate, and terminating behind the tonſils, with an aperture in the mouth, is partly bony, partly cartilaginous, and partly membranous, and internally lined with a fine membrane full of mucoſe glands: This paſſage, I ſay, ſerves principally to renew or ſhift the air, which is lodged in the inner cavities of the ear, in order to prevent its intire loſs of elaſticity by a too long confinement there. When this paſſage therefore is either obſtructed, or intirely deſtroyed, the air, contained in the ear, will be unfit for the reception and propagation of that determinate degree of vibratory motion, which is neceſſary for the act of hearing. The obſtruction of this paſſage often ariſes from a critical and catarrhous accumulation of mucus, from an incraſſation and induration of this accumulated mucus; from the ſwelling of the mucoſe glands; from membranous and fibrous excreſcences; which, upon the eroſion of the inner membrane of this paſſage, ſometimes happen, particularly by a venereal taint; and from numberleſs other cauſes. The eroſion in this caſe happens in the ſame manner, as was mentioned in the eroſion of the membranes of the bones of the ear.

The auditory nerve is the laſt, but yet a principal part of the internal ear, and the alone *copula*, or tie, by which this peculiar organ of ſenſation is connected with the common ſenſory. Whence alſo its due and regular diſpoſition is abſolutely neceſſary, in order to communicate to the ſoul, by means of this ſenſe, its proper perceptions and ſenſations. This communication or intercourſe of motion is interrupted, when the ſubtle fluid, called the nervous juice by phyſiological writers, is obſtructed in its regular motion and paſſage through theſe nerves and their principal branches. Moſt pathologiſts reckon principally, among the cauſes of this interrupted paſſage, the obſtruction of the nerve. But as from phyſiological principles, it does not appear, how this extraordinary ſubtle fluid ſhould be incraſſated, or the fibres of the nerves drawn together or contracted; the obſtruction in this caſe muſt be the ſame as when in the nutricious veſſels, and within the *involucra* or ſheaths of this nerve, accumulated, indurated, or even extravaſated juices from lacerated veſſels, being collected, compreſs the nervous fibres. The principal defect, which in theſe nerves can poſſibly interrupt the motion of the nervous juice, is, ſecondly, their compreſſion; which may ariſe either at their origin, or near the common ſenſory, or in their entire length, either internally or externally, by accumulated or even extravaſated blood, or other juices of the adjacent parts; as alſo in the ear itſelf, from a *caries* or *exoſtoſis* of its bones; which laſt has often been obſerved, particularly in venereal caſes.

Beſides theſe defects of the auditory nerve hitherto mentioned, we are principally to attend to the ſeat of this diſorder, and to its greater or leſs diſtance from the common ſenſory. For, when deafneſs ariſes from compreſſion, or even eroſion of the nerve ſpread over the labyrinth, there ſtill remains a reſource to ſupply this defect in another and that an ingenious manner; and even to produce ſuch ſenſations, as are otherwiſe communicated to the ſoul by the organ of hearing. But if the origin of the nerve, namely, that part thereof which lies neareſt the common ſenſory in the brain, is injured, it is not in the power of art to reſtore the ſenſe of hearing. Yet by all this I would not on any account deny, but that dumb perſons of this claſs, might by the eye, by a long, careful, and attentive obſervation of the different motions of the mouth in the act of ſpeaking, be brought, at laſt, to underſtand the thoughts of thoſe about them; as in *Amman*'s method, of which hereafter.

C H A P. II.

An account of the attempts formerly made for the relief of the deaf.

HOW various ſoever the cauſes of deafneſs and difficulty of hearing, hitherto mentioned, may be, many have, for a long time paſt, eſpecially more latterly, been employed in the queſt and diſcovery of the means of removing ſome way or other, or at leaſt of diminiſhing this calamity. The many eſſays for this purpoſe, made by phyſicians and inquirers into nature, may be very properly divided into two claſſes. To the firſt I refer that method, according to which, a perſon, either naturally deaf, or become ſo by ſome accident, may, by means of the other ſenſes, without the intervention of the organs of hearing, or any part of them, be enabled to have thoſe perceptions, which others obtain by the ſenſe of hearing. The ſecond claſs, on the contrary, compriſes thoſe methods, in which the auditory nerve itſelf is put in motion, and thus the very ſenſation produced in the ſoul, which we uſually call hearing. This method again is twofold: One, in which the vibratory motion of ſound is propagated to the auditory nerve, by means of the ordinary, but, in other reſpects, faulty parts of the organ of hearing; by the intervention of ſome other bodies, and by a variety of ingenious devices. The other method, on the contrary, conveys ſound in like manner to the auditory nerve, and thus produces the ſenſation of hearing, not only by means of the ordinary channels and organs, but alſo by means of the adjoining firm parts of the head.

Several phyſicians and other learned perſons have been at great pains on the diſcovery and improvement of the firſt method, in order, by the other ſenſes, particularly the ſight, without the intervention of the auditory organs, to produce in the ſoul the perceptions peculiar to the ear. But moſt of theſe attempts have only occaſionally and incidentally proved of any benefit to the hearing: As moſt of them have, in all their attempts, made it their principal view, to enable the deaf perſon to ſpeak; though, indeed, the frequent and attentive obſervation of the motions of the mouth and other parts, which concur to form articulate ſounds, may give ſuch a degree of readineſs to thoſe wretched perſons, as to enable them to underſtand and diſtinguiſh, with extraordinary quickneſs, all the motions of a ſpeaker, and thus alſo clearly to comprehend all that is ſpoken. Nature herſelf has formed moſt perſons uncommonly docile in this reſpect, though otherwiſe not endued with the brighteſt parts. Experience every day almoſt ſhews, that deaf perſons may obſerve by the mouth, that which others ſpeak; and their uncommon and great attention is the reaſon, that they have the misfortune to be generally taken by the common people for very arch and roguiſh.

But this very natural device, namely by means of the niceſt obſervation of the motions of the mouth in the act of ſpeaking, employed in order to hear, and by imitating the very ſame motions alſo to ſpeak, may be reduced to ſeveral rules, limited and determined by the genius of every language ſpoken, and thereby the learning them made much eaſier. This is that device, in which, for a century and a half back, many learned men have employed their thoughts; among whom *Peter Pontius*, *Paul Bonnetus*, Dr. *Wallis*, *Holder*, *Sibſcota*, *Franciſcus Mercurius Van Helmont*, but above all others, *John Conrad Amman*, have moſt of all diſtinguiſhed themſelves. It would carry me too far, and be inconſiſtent with my preſent deſign, were I to recite here all the attempts made by theſe learned men to this purpoſe, and their ſucceſs therein. Suffice it therefore to give a ſhort account of the lateſt attempt in that way, namely, that of Dr. *Amman*; and at the ſame time to point out its principal defect; but as to the others, briefly only to mention their writings, or other accounts we have of them. *Peter Pontius*, a Spaniſh Benedictine, who lived towards the cloſe of the ſixteenth century, made the firſt eſſay in this way, and taught deaf perſons both to write and to ſpeak. His method, which he did not himſelf deſcribe, was afterwards improved by *Paul Bonnetus*, a maſter-gunner of the king of Arragon, and explained in a particular writing, entitled, *Reduccion de las letras, y arte para enſenar a hablar los mudos*; i. e. The reſolution of the letters, with the art of enabling dumb perſons to ſpeak, Madrid, 1620, in 4to. Dr. John Wallis, who after both the former applied himſelf to improve this art, gave a deſcription thereof, both in his *Tractatus grammatico-phyſicus de loquela*, and in his letter to the honourable Mr. Boyle, *de ſurdis mutiſq; informandis*. The former tract is alſo prefixed to his *Grammatica linguæ Anglicanæ*, publiſhed in 1653, and was afterwards often publiſhed with Dr. *Amman*'s writing. But the latter we have in the *philoſophical tranſactions*, No. 41; as alſo in the *Ephemerides acad. nat. curioſor, Dec.* 1. *Ann.* 1, in *append.* p. 11. & *ſeqq.*

About the ſame time Dr. *Holder*, ſubdean of the king's chapel, publiſhed in 1669, in 8vo, a book, called *Elements of ſpeech*, &c. together with the art of teaching deaf and dumb perſons to ſpeak. In the year immediately following, namely 1670, George Sibſeſta publiſhed, alſo at London, the following book, namely, *Deaf and dumb man's diſcourſe, or concerning thoſe who are born deaf and dumb*; to which he ſubjoined a treatiſe, *De ratione loquelæ creaturarum animatarum*. Laſtly, the younger *Van Helmont* attempted to explain more diſtinctly, the natural formation of the letters of the alphabet, for the benefit of the deaf and dumb; but he has confined himſelf to the Hebrew language, and given his rules in his *Alphabetum naturale Hebraicum*, which has been ſeveral times reprinted: I have ſeen an abſtract of it under the following title, *Franciſci Mercurii ab Helmont alphabeti verè naturalis breviſſima delineatio, quæ ſimul methodum ſuppeditat, juxta quam, qui ſurdi nati ſunt, ſic informari poſſunt, ut non alios ſolum loquentes intelligant, ſed et ipſi ad ſermonis* them. *Peter Pontius*, a Spaniſh Benedictine, who lived towards the cloſe of the ſixteenth century, made the firſt eſſay in this way, and taught deaf perſons both to write and to ſpeak. His method, which he did not himſelf deſcribe, was afterwards improved by *Paul Bonnetus*, a maſter-gunner of the king of Arragon, and explained in a particular writing, entitled, *Reduccion de las letras, y arte para enſenar a hablar los mudos*; i. e. The reſolution of the letters, with the art of enabling dumb perſons to ſpeak, Madrid, 1620, in 4to. Dr. John Wallis, who after both the former applied himſelf to improve this art, gave a deſcription thereof, both in his *Tractatus grammatico-phyſicus de loquela*, and in his letter to the honourable Mr. Boyle, *de ſurdis mutiſq; informandis*. The former tract is alſo prefixed to his *Grammatica linguæ Anglicanæ*, publiſhed in 1653, and was afterwards often publiſhed with Dr. *Amman*'s writing. But the latter we have in the *philoſophical tranſactions*, No. 41; as alſo in the *Ephemerides acad. nat. curioſor, Dec.* 1. *Ann.* 1, in *append.* p. 11. & *ſeqq.*

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uſum perveniant, *Ann*. 1667, in 12mo, *cum fig*.

But above all others, *John Conrad Amman*, a phyſician of Amſterdam, diſtinguiſhed himſelf more, towards the end of the laſt century, by his ingenious method of teaching the deaf and dumb to ſpeak: And after having happily ſucceeded in his method, not only on a deaf and dumb girl at Harlem, but alſo on his own daughter, and on ſeveral others, he publiſhed, in 1692, at Amſterdam, his Tract of *Surdus loquens*, in 8vo, wherein he laid open the whole of his method. Which being afterwards publiſhed in Engliſh by Daniel Foot, and highly approved by the learned, he gave a new and more enlarged edition of it at Amſterdam in 1700, in 8vo, under this title, *Diſſertatio de loquela, qua non ſolum vox humana et loquendi artificium, ex originibus ſuis eruuntur, ſed et traduntur media, quibus ii, qui ab incunabulis, ſurdi et muti fuerunt, loquelam adipiſci, quiq; difficulter loquuntur, vitia ſua emendare poſſint*. And afterwards there came out ſeveral editions thereof, a proof of the good reception it met with from the public. On this foundation *William Kerger* eſtabliſhed his method in his epiſtle *De ſurdo-mutorum cura,* publiſhed in the appendix to the *Ephemerid. Acad. nat. curioſor. Cent.* I. & II. *p.* 233. *ſeqq.* accommodating his inſtructions to the German language, together with a ſuccinct account of his predeceſſors in the ſame method of treatment.

The whole of this method reſts on that well known phyſiological principle, inconteſtably confirmed by daily experience, namely, that we communicate our thoughts to each other by means of articulate ſounds, formed by the organs of ſpeech, which we call language: And, by a daily practice, we inſenſibly learn to form with every conception, a certain articulate ſound. The ſimple articulate ſounds are generally four and twenty, and in ſeveral languages fewer, called letters of the alphabet; which, when combined according to certain rules, and pronounced at once like a ſingle articulate ſound, are called ſyllables, and a farther combination forms that which we call words. But all theſe articulate ſounds, in order to their production, require, at the ſame time, a certain viſible alteration and motion in the organs of ſpeech, namely, the lips, teeth, tongue, cheeks, larynx, &c. For inſtance, all ſounds, articulated by a bare aperture of the mouth in different degrees, are called vowels: And all others, formed by means of the other parts, are mutes or conſonants. And, indeed, the accurate attention to, and careful imitation of, all the particular motions requiſite to the articulation of ſounds, conſtitute the whole of *Amman*'s method.

As in this, or in any other method of the ſame kind, the organs of hearing contribute nothing to the effect, it may indeed, be employed in all the defects and imperfections of the auditory organs, by which either deafneſs or a difficulty of hearing is produced. This method, however, is ſubject to ſeveral conſiderable imperfections, which render it greatly inferior to ſome of the following methods, by which the auditory nerve itſelf is at the ſame time made to be affected. In the firſt place, let us ſuppoſe a caſe, and which actually happens, as appears from the hiſtory of diſeaſes, namely, that ſuch a perſon is born deaf, dumb, and blind.

No one, certainly, though more dexterous than *Amman* himſelf, could, by that method, impart the conceptions, which, in other reſpects, ariſe from the ſenſe of hearing. But then it may be alledged, that if he cannot ſee, he may feel, at leaſt. I grant, that he may learn to ſpeak in that manner: But then, for one in this condition, to lay his hands on the mouth and throat of the ſpeaker, would appear clumſy and aukward: Not to mention, that in forming ſounds, ſeveral motions are performed with the tongue, the teeth, the cheeks, the gums, &c. moſtly obſervable by the eye, but not properly to be felt, without interrupting the ſpeaker at the ſame time.

The ſecond imperfection in this method, conſiſts principally in confining the conceptions imparted, barely to language. All thoſe raviſhing ſenſations, which, in other reſpects, the ſenſe of hearing is ſuſceptible of, are here quite loſt; nor can the thrilling motions of the organs of ſpeech, inſtantaneouſly loſt in each other, when raiſed with that rapidity in the expreſſions of the deeper Paſſions, as to ſtrike and ſurprize the hearers, be once diſtinguiſhed by, much leſs yield, that melting ſenſation to a perſon ſo wretched. Much leſs could a ſkilful muſician throw him into thoſe ſoft and calm raptures, when under his hands, the ſtrings, in harmony truly divine, thrill the hearer with unſpeakable delight. Thirdly and laſtly, take a perſon of little or no natural abilities, and attempt to teach him in this manner; I am fully perſuaded, that all the pains taken with him, would be quite loſt: Not *Amman* himſelf, with all his art and practical ſkill, could hope to ſucceed in a caſe of ſuch indocility.

I now proceed to the ſecond order of the attempts made to reſtore hearing to the deaf, by putting the auditory nerve itſelf in motion, thereby producing the ſenſation of hearing. I have already ſhewn above, that this order may be properly divided into two ſorts. To the firſt belong the methods of propagating ſound in a due degree of motion, by the ordinary though faulty organs of hearing, quite to the auditory nerve. To this we may juſtly refer all thoſe contrivances, which, either by peculiar inſtruments, or other means or devices, raiſe or heighten the motions and repercuſions of the air in the channels and cavities of the ear; when thoſe parts are ſo faulty as not to be put into the proper vibratory motions by the ordinary action of ſound. And in this caſe it is always requiſite, that the auditory channel be open.

When the auditory channel is thus open, or the other parts of the inner ear connected therewith are ſuſceptible of ſome, though a very faint degree of, vibratory motion, and only require a greater action of the inſinuating air than is neceſſary in a natural ſtate, there hence ariſes a difficulty of hearing, and not a perfect degree of deafneſs. Now as among the ſeveral methods of propagating ſound, by means of the parts mentioned, to the auditory nerve, in natural order, they are only of ſervice in difficulty of hearing, but not in the caſe of perfect deafneſs; I ſhall therefore mention only, in brief, ſome of the means of this ſpecies of method. And one of the beſt known, and which nature herſelf, for the moſt part, points out, is, to apply the hand bent and hollow to the ear, and thereby not only to convey a greater quantity of vibrating air to the auditory channel, but likewiſe to raiſe or heighten its repercuſſions. With this view alſo, ſuch perſons generally ſet the mouth wide open, when they want to hear more accurately; that the air, reflected from the palate, may be forced through the *tuba Euſtachii* into the cavity of the drum, and thereby render more intenſe the vibration of the air. But then we are to ſuppoſe this laſt mentioned channel to have no obſtruction.

And this very heightening the action of ſound, is procured by means of peculiar inſtruments. Of this ſort are acouſtic trumpets or horns, inſtruments commonly well known, and which require no particular notice to be taken of them here. Somewhat leſs known is the ingenious acouſtic drum of Father *Sebaſtian Truchel,* a Carmelite monk, which, in 1718, he preſented to the royal academy of ſciences at Paris, and which had their approbation. This drum conſiſts of gold-beater's ſkin, which is originally ox gut. This ſkin is ſtretched either on a round or an oval hoop, as is commonly done in drums; ſo that when faſtened to the ear, it forms, with the natural membrane of the drum of the ear, a perfect drum; the artificial ſkin exhibiting the part which is ſtruck upon; the ear itſelf again and the auditory channel, the kettle or hollow cavity of the drum; and the natural membrane of the drum of the ear, the undermoſt ſkin of the drum. The artificial ſkin had, beſides, over it, a raiſed cover, in ſhape of a box, whoſe aperture was turned to the mouth of the ſpeaker. A perſon hard of hearing in both ears, may, by means of a ſemicircle of braſs or ſilver, which goes round the hinder part of the head, under the hair or peruke, faſten two ſuch drums to his ears.

We are now at length come to the other method of the ſecond claſs or order, compriſing thoſe means which convey ſound, and thereby reſtore actual hearing by extraordinary ways, and not by means of the natural auditory channel, to the auditory nerve. But before I explain the

peculiar

peculiar methods under this head, I muſt here borrow three prepoſitions as principles, from natural philoſophy and anatomy, as they properly afford a natural foundation and reaſon for all the methods that are now to follow, and to all the remarks that may occaſionally offer, as we proceed. In the firſt place, ſound is propagated by bodies elaſtic, and ſuſceptible of a vibratory motion. Secondly, propagation of ſound is interrupted by ſofter interpoſing parts, unſuſceptible of any, or of but faint vibrations. Thirdly, the bones of the ſkull, in which the auditory nerves are lodged, form, with the upper maxillary bone, one continued hard and elaſtic body, uninterrupted in their connection by any ſofter parts, and hence extremely well adapted for the propagation of ſound.

As I have adduced theſe prepoſitions principally with the view that the attentive reader may have them conſtantly in his eye, either in paſſing a judgment on, or in explaining, the ſeveral methods, which, indeed, produce the ſenſe of hearing by means of the auditory nerve, but not by the natural auditory channel, to which claſs alſo my own method, which I am now about to explain, does belong; ſo I ſhall at preſent, firſt, hiſtorically relate the ſeveral imperfect attempts of this kind: And then, ſecondly, deſcribe my own method, in all its circumſtances, and in the whole of the manner of procedure. Thirdly and laſtly, explain it in its phyſical and phyſiological principles, and at the ſame time determine the particular caſe, in which it is abſolutely inapplicable.

We have extant experiments of a long ſtanding, the firſt careful attention to which is generally, at leaſt by Father *Kircher*, in his *Muſurgia univerſalis*, P. II. p. 559. aſcribed to the celebrated Neapolitan *John Baptiſta Porta*; namely, that we can, for inſtance, hear the ſound of a ringing fork, when ſtriking its fore-part, or prongs, on another hard body, we hold its handle to the teeth. The very ſame thing is obſervable in a pair of tongs, a ſteel wire, a ſword-blade, &c. when ſtruck in the ſame manner, and applied to the teeth. Moreover, that we diſtinctly hear all the tones or notes of a muſical inſtrument, when played upon, on taking it in the teeth, or touching it with a wire, ſword-blade, &c. held in the ſame manner. Travellers, who happen to ſtray in the night, upon laying the head, eſpecially the hinder part, cloſe to the earth, may hear diſtinctly, at the diſtance of a German mile or more, people going, riding, or travelling. In this manner, ſome of the inhabitants of *Halle* could, on the neighbouring eminences, hear all the cannon fired in the glorious battle of *Roſbach*, in as diſtinct and plain a manner, as if at no great diſtance from the action, though at that time full four German miles off. *Conrad Victor Scheider*, ſo celebrated for his deſcription of the mucoſe glands of the noſe, in his book, *De oſſibus temporum*, publiſhed at Wittemburg in 1653, in 8vo, p. 43, relates the ſame thing of ſome peaſants, who ſticking their ſtaves in the earth, held one end in their teeth; to wave other inſtances at preſent.

All theſe experiments ſucceed as well, if not better, with deaf perſons, than with thoſe that have their hearing: As thoſe laſt, upon ſtopping their ears, feel a tingling and whizzing from the included air, which the former are without. The proof of this I refer to the experience of all deaf perſons who will make the trial. For, caſes, where deafneſs cannot be relieved by this method, and which I ſhall mention towards the concluſion, are very rare: Nay, the practice of ſetting the mouth wide open, in difficulty of hearing, in order more diſtinctly to hear, is in ſome meaſure reducible hither: Though, in explaining this obſervation, I muſt differ from very great phyſicians, who would account for this manner of hearing, ſolely from the air inſinuated into the *tuba Euſtachii*; which I ſhall more fully treat below.

That the methods of hearing but juſt mentioned, without the uſe of the ordinary organs of hearing, has been confirmed by the repeated obſervations of phyſicians and inquirers into nature, I ſhall briefly illuſtrate from ſome credible hiſtories, which may, at the ſame time clear up, and ſhew the different application of the method I am now upon. *Boerhaave*, a man, whoſe teſtimony is every where unexceptionable, tells us in his *Prælectiones academicæ in proprias inſtitutiones medicas*, T. IV. p. 414. according to Haller's edition, of a deaf Muſician, who, laying hold with his teeth in the upper parts of his lute, at the tuning pegs, played in a manner perfectly juſt, and according to all the rules of art, without the leaſt miſtake or blunder. Like inſtances we have in *Ingraſſias*, in his *Commentarii in Galeni librum de oſſibus*, *Schelhamer* in his book *De auditu*, and in *Du Verney*, in his treatiſe on hearing.

Du Verney, just now mentioned, as alſo *De Lanis*, in his *Magiſt. natur. & artis*, p. 928, and others, have farther obſerved, that deaf perſons have been enabled to hear extremely well, if, in ſpeaking, one ſhould direct the ſound over and againſt the head. A curious inſtance of this we find in the *Ephemerides academ. nat. curioſor. decur.* 1. *ann.* 1. *obſerv.* XXXV. which is the more remarkable, as the principal circumſtance therein lies buried in the rubbiſh of trifling quack medicines. *Emanuel Ramireſius de Cariour*, a Spaniard, is the inventor of this method, of whom *Petrus a Caſtro,* phyſician to one of the Dukes of Mantua, learned it, and to whom we owe the account. The whole of it conſiſted in the following particulars. In the firſt place, the patient, according as his conſtitution might require, was to uſe a proper laxative, and then once or twice a ſomewhat ſtronger purgative; after which the head was to be ſhaved at the coronal ſuture, for a hand's-breadth, and often rubbed, eſpecially morning and evening, with the following ſalve: Take three ounces of the beſt brandy, two drams of purified ſaltpetre, one ounce of oil of bitter almonds, ſet the whole to boil gently, till all the brandy is evaporated, then pour to it an ounce of orange water, *(aqua naphæ)* ſtir it with a ſpatula, till it turns of the conſiſtence of a thin ſalve. Laſtly, early every morning the patient muſt clean, perfectly well, his head and eyes, and clear his ears and noſe, rinſe his mouth, and chew ſome maſtich, or other fragrant ſubſtance, and then do his hair back with an ivory comb; this done, the ſpeaker is to direct his voice juſt over the ſhaven part, and the deaf perſon comes to hear perfectly and diſtinctly every word that is ſpoken: And thus the deaf learn, not only to hear, but to ſpeak. The reaſon of all this will appear below.

But as the methed of *Ramireſius* is attended with many inconveniences, and as it muſt be very troubleſome, not only to the patient, on account of ſuch antecedent preparation, but to the ſpeaker alſo. The following methods of producing this ſenſe, by means of ſome elaſtic body held to the teeth, claim, by much, the preference: Of this the experiments adduced above are ſufficient proofs. But the following account, taken from the *Breſlaw collection*, *Eſſay* 21. p. 330. is ſtill a fuller proof. A man at *Copenhagen* had, by diſtemper, loſt his hearing, to ſuch a degree, as not to have the leaſt ſenſe of firing of cannon, the beating ever ſo many drums, nor of any other the moſt violent motions: At laſt, he accidentally fell on a method, by which he could perfectly well underſtand any ſpeaker, and write down all that he ſaid; and this he did by means of a ſtick of wood, of a moderate length, one end of which he held to, or took in his teeth, reſting the other end againſt the place where the ſpeaker ſtood. And thus at church he could underſtand the preacher, and write down the ſermon, upon ſeating himſelf juſt under the pulpit, with his face towards it, and one end of the ſtick, while the other was between his teeth, reſting againſt the foot of the pulpit.

About ten years ſince, *John Paul Baumer*, a young phyſician of *Franconia*, undertook to improve this method: And in a writing, which we ſhall preſently mention, he pretended, he himſelf had deviſed the whole of the method, explaining it from the nature of the ſenſe of hearing, and from the different manner of propagating ſounds; but now and then ſomething eſcapes him, which bewrays, that he was not altogether unacquainted with that which others had attempted before him in that way. He publiſhed his method in an inaugural diſputation at Erfurt in 1749, under the following title, *Prodromus methodi ſurdos a nativitate faciendi audientes & loquentes*. The whole conſiſts in taking a ſtick, made of an elaſtic body, or glaſs, ſteel, copper, bell-metal, ſilver, &c. flat and broad at both ends, to prevent its touching the lips; and being thus made fit for the due propagation of ſound, one end of this ſtick the deaf perſon takes between his teeth, and the ſpeaker the other, with this precaution, however, that neither of them ſhall touch the ſtick with the tongue or lips: In this manner, the deaf perſon hears every word that is uttered.

In order the more fully to eſtabliſh the utility of this method, the author gives an inſtance in his ſecond remark, § 6. of a young woman of twenty-four, who learned to hear in this manner, though with an old ruſty piece of a ſword-blade, about two feet long: For, upon pronouncing only a few words, ſhe, with a ſmile, and pointing to her head, intimated, that ſhe perceived every word that was ſaid, and directly attempted to imitate them. But, as there are many defects in this method, as namely, that the ſtick muſt not be touched either with the lips or the tongue, in which caſe, all the lingual and labial letters, as b, d, f, l, m,

&c. muſt be uttered indiſtinctly; to obviate which, the author, indeed, has, § 15 and 17. of his diſputation, propoſed another method, by uſing an acouſtic tube, and a ſpeaking trumpet. If the firſt, the deaf perſon muſt take it in his teeth, and the ſpeaker muſt pronounce at the wide end of the tube; which purpoſe a common funnel will anſwer as well: But if a ſpeaking trumpet, the deaf perſon muſt open his mouth very wide, while the ſpeaker, who pronounces through it, holds its upper broad part cloſe to the teeth of the deaf perſon, yet without touching them.

CHAP. III.

An account of the beſt and eaſieſt method to make deaf perſons hear.

TO conclude, all the methods hitherto metioned under this ſecond claſs, are rendered far more commodious, more perfect, and of far more general utility, by conſidering a peculiar inſtance of an ingenious deaf perſon, who gave the greateſt attention to every incident that offered to his obſervation: And this method I ſhall now propoſe at full length, as the eaſieſt and beſt to enable deaf perſons to hear. I am not, indeed, the firſt who publiſhed the account, and an explanation of it; as an unknown author, under the initial letters C, F, W. has already deſcribed it in the Harlem Journal for the year 1754, *p.* 393. *ſeqq.* but as both his hiſtorical part is erroneous and imperfect, and the explanation of its circumſtances, and the obſervations made thereon, are groundleſs and falſe; I had the whole matter more fully and more juſtly deſcribed, a year and an half ſince, in an academical diſputation, defended under my preſidentſhip, with the following title, *Diſſertatio ſiſtens novæ methodi, ſurdos reddendi audientes, phyſicas & medicas rationes.* But as ſuch diſſertations ſeldom come into the hands of any, but of phyſicians, I ſhall here, firſt, relate the hiſtory of this deaf perſon, in all its circumſtances, together with the manner in which he recovered his hearing. Then, ſecondly, give a rational explanation, grounded on phyſical and medical principles, of all the incidental circumſtances obſervable therein.

A reputable merchant of *Weſel*, in the Duchy of *Cleves*, a venerable, hoary, old man of ſeventy-eight, had, as early as his twentieth year, a great difficulty of hearing, which, as far as he could recollect, was occaſioned, either by a violent fall, or by a profuſe bleeding at the noſe. The moſt promiſing means againſt this diſorder proved ineffectual, it rather growing upon him from year to year, till, at laſt, he became quite deaf, unable to underſtand a ſingle word, without bawling loud in his ears. Both German and Dutch phyſicians, who were conſulted on this occaſion, could not, with all their art and ſkill, afford any relief: At length, after an accurate examination of the external organs of hearing, the caſe was deemed incurable. However, he procured a variety of acouſtic tubes from Amſterdam, in order to afford ſome relief to thoſe who wanted to ſpeak with him: But their uſe was afterwards laid aſide, as being attended either with much inconvenience, or as never procuring any diſtinct degree of hearing.

Afterwards marrying, and having two of his eldeſt children, a ſon and a daughter, taught to play on the ſpinnet, he often came up to it, and eagerly wiſhed to hear the muſic: As the muſic-maſter once happened to ſay, that it was very poſſible for him to hear, if, according to an old, and well known experiment, he held a thin ſtick, or a tobacco-pipe, with the one end on the bridge of the ſound-board, and with the other to the upper teeth; this he inſtantly tried, and was greatly pleaſed, that he could both plainly diſtinguiſh each note, and, as he thought, much ſtronger than formerly, at his beſt hearing. But all this was ineffectual to make him underſtand perſons ſpeaking, till an accidental trial procured him alſo this happineſs.

In the year 1749, he had the good fortune to light, by mere accident, on a peculiar method, by which any perſon, at the diſtance of twenty, or even thirty paces, may, without greatly ſtraining his voice, ſpeak to be underſtood. This happened as follows: As one time this deaf perſon had all his family about him, and was pleaſing himſelf with his daughter's playing, by means of his tobacco-pipe; his brother, who happened to be preſent, alledged, that as he could plainly diſtinguiſh the ſounds or notes of the ſpinnet, he might alſo, in the ſame manner, underſtand the articulate ſounds of a ſpeaker. For this purpoſe, his brother took a ſpeaking-trumpet, and holding the narrow part, or mouth-piece, to the upper teeth of the deaf perſon, he uttered a few words at the upper or wider part thereof: This trial, however, proved unſucceſsful, the deaf man not being ſenſible of the leaſt articulate ſound. But he himſelf directly fell upon a device, which proved more ſucceſsful. The brother was to hold the rim of the wide end of the ſpeaking-trumpet to his upper teeth, and he himſelf to do the like with the lower end, or mouth-piece: Upon which, his brother had ſcarce uttered a couple of words, but he directly repeated them with the greateſt joy, and alſo aſſured him, that he underſtood them more diſtinctly than if he had bawled them in the loudeſt manner in his ear.

The deaf man did not ſtop here: In order to be convinced, whether the ſucceſs was not owing to the ſtructure of the ſpeaking-trumpet, or whether the ſame thing might not ſucceed with other bodies; he directly tried, in the ſame manner, his tobacco-pipe, and a little wooden ſtick, and to his great joy found it not only poſſible, but that the ſpeaker might even ſpeak as low as he pleaſed, ſo the voice were only audible. The curioſity of this man and his friends did not reſt here; they wanted to know, at what diſtance one might converſe with him: For this purpoſe, they took thin ſticks or ſlips of wood, of different lengths, and one, in particular, ſix feet long, an inch broad, and of the thickneſs of the back of a knife. At Weſel, and in the country round about, they call ſuch ſticks flooring-ſlips or laths, which they uſe in filling up the openings of the boards of the flooring, when ſtarting aſunder: And ſuch ſlips are the more commodious, as being thin, they the leſs hinder the pronunciation, and as in other reſpects, they produce the ſame effect in propagating ſound: And even, by means of a bundle of them tied together, the loweſt ſound is diſtinctly audible, when the by-ſtanders can ſcarce perceive any.

The farther trials and obſervations, which were made in the uſe of this method, have been confirmed by the following experiments. In the firſt place, upon bawling in the loudeſt manner, in the mouth of the deaf perſon, through a large tin funnel, without touching the teeth, or even without the funnel, not a ſingle word was underſtood. Secondly, if the ſlip of wood be held too faſt with the finger, or laid hold on with ſhut lips, the voice proves very indiſtinct. But thirdly, if held with the teeth, the ſenſation is extremely weak. Fourthly, if the ſlip be held to the under teeth, there is not the leaſt ſenſe of hearing. Whereas, fifthly, the voice is perceptible and diſtinct, upon bringing, in uſing the ſlip, the tongue to the palate or to the teeth. Sixthly, the voice is leſs perceptible on joining the teeth together, than on their ſtanding aſunder. Seventhly, though the mouth be full of water, the hearing is not in the leaſt diminiſhed. Eighthly, when a braſs or iron wire is held to the teeth, the deaf perſon hears nothing at all; but held between the teeth, a little. Ninthly, the deaf perſon may hear very well, on holding, by the lower rim, a beer-glaſs, to the upper teeth; or if, with the mouth ſhut, he preſſes it ſomewhat hard juſt under the noſe, and another perſon directs his voice up the glaſs, cloſe to it; all which anſwers not with a wine-glaſs. Tenthly and laſtly, the ſpeaker muſt have good ſound teeth, without any looſe ones, at leaſt in the upper jaw, as then the voice is very indiſtinct.

As the explanation of all the methods hitherto treated, and the obſervations occaſionally offering thereon, are founded on the three phyſical and medical propoſitions, advanced above; all that is neceſſary here, is to make a cloſer application of them to the preſent caſe, and from the conſequences thence drawn, give a ſufficient proof of the commodiouſneſs and utility of the laſt method propoſed, to procure hearing to the deaf. And thus, in the firſt place, I ſhall briefly handle the propagation of ſound, ſo far as is neceſſary to my preſent purpoſe. Secondly, mention thoſe parts of the body, which either obſtruct, or promote this propagation. Thirdly, deduce from their ſeveral cauſes the peculiar obſervations, made in the foregoing paragraph. Fourthly and laſtly, determine briefly thoſe caſes, in which the application of this method does not take place.

Inquirers into nature ſhew, that the propagation of ſound depends principally on elaſtic bodies, that is, ſuch, whoſe parts reſiſt the action of another body upon them, and which, when thereby altered in ſituation, reſtore themſelves to their former ſtate, from a force, not ariſing from their gravity, but peculiar to them. For, ſound is nothing other but the tremulous, or vibratory motion, ariſing from elaſticity, of the minuteſt air-particles, whereby a peculiar ſenſation is produced in the auditory organs. Now, as this vibratory motion, and the ſound produced thereby, are ſolely owing to the elaſticity of bodies, we may thence fairly infer, that all elaſtic bodies are ſonorous; for inſtance, glaſs,

bell-

bell-metal, copper, ſilver, ſteel, &c. But, in order to one body's acting upon another, they muſt come either into mediate or immediate contact with each other. For, action at diſtance, *actio in diſtans*, is both, by phyſical and metaphyſical principles, a non-entity, a mere fancy. Now, as daily experience ſhews, that ſound takes its riſe at a diſtance from the ear, and thus only mediately, namely, by another intervening body, puts in motion the auditory organs; it follows hence, that the body producing this mediate effect, muſt be elaſtic, as the propagation of ſound is not poſſible by means of any other body.

The elaſtic body, which commonly propagates ſound, is the air; but it is poſſeſſed of this virtue from no other quality, but from that of its elaſticity. Conſequently, all elaſtic bodies without exception anſwer this purpoſe, ſo that they only affect the organs of hearing, or are continuous with them. Of this we have undoubted proof from well-known experiments. Beſides the inſtances adduced above, it is a thing we may daily obſerve

ſerve in muſical inſtruments. The tremor or vibration, imparted to the ſtring of a ſpinnet or violin, and the like inſtruments, is propagated from it to the bridge, and thence again to the ſound-board; and in the inſtance we are now upon, from the bridge of the ſpinnet to the tobacco-pipe, and thence farther on, till it reaches, and puts into a ſimilar motion, the organs of hearing; and the parts themſelves of our body are adapted for this propagation. For inſtance, hang a little bell, cymbal, pair of tongs, &c. by means of a metal wire or gut-ſtring, on the finger, and with that finger ſtop the ear, and ſtrike upon or move any of theſe bodies, and the ſound is perfectly well perceived: Or take a watch by the chain between the teeth, and ſtop the ears cloſe, and you will very diſtinctly hear it go.

As in theſe caſes, the ſound is propagated from the mouth to the ear, though the air, which is put in motion, is no ways connected with the external ear; in that caſe it muſt be, that the parts of the head, lying between the mouth and the organ of hearing, are the means of propagation. But as it is well known from phyſical grounds, that ſoft parts, ſuſceptible of little or no degree of vibration, are not only in themſelves incapable of propagating ſound, but even obſtruct, or, at leaſt, diminiſh its farther propagation, when happening to interrupt the connection of the hard and elaſtic parts: The hard and elaſtic parts, therefore, of the body, uninterrupted in their cloſe connection or continuity by the intervention of ſofter parts, are alone fitteſt for this purpoſe.

I ſhall now briefly mention, as I promiſed above, all theſe hard parts of the head, with their ſeveral connections with each other; from all which, their capacity or incapacity to propagate ſound will be more eaſily and certainly determined; and ſhall begin with the under parts, where, according to the experiments above mentioned, the communication and propagation of ſound took its riſe; and thus ſhall proceed to the upper parts. And firſt, the teeth offer to conſideration, which are parts extremely hard and firm, and by an articulation, called *gomphoſis*, wedged or fixed immoveably in their cavities or ſockets, in both the jaw-bones, ſo as not to drop out even in a ſkeleton. In the ſecond place, follows the under jaw-bone, both whoſe *apophyſes condyloideæ* are obliquely inſerted in the *fovea glenoides* of the temporal bone, and move over the oblique eminence of the ſame bone, by means of the *cartilago interarticularis*. Thirdly, the upper maxillary bones come to be conſidered, whoſe hinder and inner part is immediatly connected with the *apophyſes pterygoides* of the *os ſphenoides*; but the fore-part firmly connected with the palatine to the *oſſa palati*, and with the zygomatic proceſſes to the *os zygomaticum*. Then, fourthly, follows the juſt mentioned *os jugale*, or *zygomaticum*, which, by a peculiar proceſs, is cloſely connected, backwards, with the temporal bone. Fifthly, the palatine bones are connected with the *os cuneiforme* by the pterygoidal proceſſes. Sixthly, the *os cuneiforme* lies in the middle, between the ſaid bones, and forms, as it were, the common copula or tie of theſe and of the temporal bones; ſeeing it is connected forwards with the palatine bones by the pterygoid proceſſes, and by the temporal proceſſes, called by ſome the greater wing of the os cuneiforme, with the *os ſquamoſum* and *petroſum* of the temporal bone. Hence, ſeventhly, it appears, that the temporal bone is immediately connected with the *os jugale* and *cuneiforme*, and mediately with the palatine bones, and both the maxillary bones, and with the teeth; yet ſo, as that the connection with the inferior maxillary is interrupted by an interpoſing cartilage. Eighthly, the connection of the temporal with the other bones of the cranium, as the *oſſa frontis, ſincipitis*, and *occipitis*, is either mediate, by means of the *os cuneiforme*, or immediate, by means of the ſutures; which laſt, in more advanced years, intirely diſappear. Ninthly and laſtly, to this head we refer the *tuba Euſtachii*, a canal, partly bony, partly cartilaginous, and partly membranous, and cloſely connected with the temporal bone.

From this connection of bones, we may plainly ſee, that ſound is propagated by ſuch of them, as are continuous, and cloſely connected together, and are, as much as may be, either bare and naked, or only covered with thinly expanded ſoft parts: Of this kind are principally the upper teeth, then the upper maxillary bone; alſo all the bones of the cranium, when ſtript of their hair, and their other ſofter parts, are a little ſtretched, either by the hand, or ſome aſtringent. And this is the foundation of *Rameſius*' method, very eaſily explicable from that which we have juſt ſaid. On the contrary, where there is neither no perfect and continuous connection of bones with each other, particularly with the temporal, which contains the internal ear, or where too many ſofter parts lie round or between the bones, the propagation of vibratory motion, and conſequently of ſound, is, according to phyſical principles, impoſſible: On this account, neither the under maxillary bone, nor the *tuba Euſtachii*, can properly propagate ſound. Of the laſt we are, moreover, to obſerve, that being membranous from the pterygoid proceſſes to its opening into the mouth, and partly alſo lax, and on that account exhibiting a ſomewhat collapſed paſſage, the vibrating air can neither be conveyed in ſufficient quantity, to the cavity of the drum, nor produce in it the due vibratory motion.

As ſound may be propagated by all elaſtic bodies, in cloſe connection or contact with each other; ſo in this caſe may be of ſervice all thin ſlips of wood, Spaniſh reeds, ſword-blades, tobacco-pipes, &c. when preſſed to the above-mentioned hard and elaſtic parts of the head, which ſtand connected with the temporal bones. Now, as among all the elaſtic bodies juſt mentioned, the fibres of wood are remarkably tough and flexible, and on account of their looſe and open texture, give no great reſiſtance to vibratory motions, but rather afford them greater ſcope; ſo thin ſlips of wood, or ſlender Spaniſh reeds, are beſt adapted for the purpoſes of propagating ſound to the elaſtic parts of the head, and to the organs of hearing.

From the principles hitherto advanced, may be explained all thoſe experiments, which were made on occaſion of actually employing this method, and briefly recited above. The firſt experiment, either with the large funnel, or with barely ſpeaking into the mouth of the deaf perſon, in order to produce the ſenſe of hearing, miſcarried in the execution: For, as in this caſe, the air alone is to communicate to the teeth, and other elaſtic parts connected with them, a vibratory motion; it is in general unfit for this purpoſe, as it comes greatly rarified from the mouth of the ſpeaker, and conſequently, greatly diminiſhed in activity and elaſticity: Beſides, from the property common to all forced fluids, as ſoon as it has eſcaped the mouth of the ſpeaker, it expands every way, and thereby becomes ſtill more weakened in its efficacy, and conſequently cannot, in that caſe, overcome the reſiſtance of the teeth, and other elaſtic parts of the mouth of a deaf perſon, nor put them into vibratory motion, ſufficient to produce the ſenſe of hearing.

The ſecond, third, and ſixth experiments, in which the voice proved too weak and imperceptible to the deaf man, when the ſlips of wood were held too faſt with the fingers, or ſhut lips and teeth, as alſo when held to the ſhut teeth, may be explained in the ſame manner. From the foregoing propoſitions it is evident, that the ſofter parts of our body interrupt the progreſs of ſound, receiving indeed the vibratory motion, but for want of the requiſite re-action not propagating it far enough: And for this there is alſo another reaſon, namely, that in the three former methods of applying the ſlip of wood, the ſame degree of force muſt put in motion a far greater quantity of the vibratory air, than can happen in different and oppoſite circumſtances, whence, of neceſſity, a leſs effect muſt enſue: Now, as in the third and ſixth experiments, a greater ſhare of vibration is loſt in the under jaw-bone, the ſenſation thereof muſt, of courſe, be extremely weak and indiſtinct.

And this farther explains the fourth experiment, by which the deaf perſon perceived not the leaſt ſound, on holding the ſlip to the under teeth. To explain this obſervation there can be no difficulty, when we recollect the connection of the under jaw-bone with the temporal: The under jaw-bone having its connection with the reſt of the bones of the head, only by means of ſoft interpoſing parts, namely, a ſoft cartilage, which, beſides, on account of the conſtant moiſtneſs of thoſe parts, is lower, receiving, indeed, the vibratory motion, but directly again loſing it, and, as it were, deadening it, in its ſofter ſubſtance, for want of the requiſite re-action; how is it poſſible then to expect any alteration in the other bones of the head from the vibratory motion of this bone?

The fifth experiment, on the contrary, is ſomewhat more difficult to explain: For, as here the tongue, a ſofter part, is brought to the palate and teeth, and yet that which another utters remains diſtinct and perceptible to the deaf perſon, it ſhould ſeem, that this experiment contradicts the ſecond, third, and ſixth.

But here we are to conſider, that, in the firſt place, the tongue is applied behind the teeth. 2dly, That all ſoft parts, as fully appears from phyſics, receive not ſuch a quantity of vibratory motion, as do hard bodies: Whence it is, as the teeth are as it were wedged in the upper maxillary bone, being a hard part, the greateſt ſhare of vibration will go to the jaw, and only a ſmaller ſhare thereof to the tongue: But, if you ſlip the tongue forwards over the teeth, the ſame thing happens as in lips together; either no ſound at all, or but very indiſtinctly, being perceivable by the deaf perſon.

The ſeventh obſervation, namely, that the hearing is not diminiſhed, though the mouth be full of water, is eaſily accounted for; as we learn from philoſophy, that there is much elaſtic air in water, adapted for the propagation of ſound; as ſufficiently appears from the example of divers, who, under water, perceive the ſound produced above water: Now, as water perfectly encreaſes the continuity of the parts in the mouth, and propagates the vibrations produced by ſound from the teeth to the maxillary bones, and the pterygoid proceſſes of the *os cuneiforme*, we may, from the connection of theſe parts with the temporal bones, eaſily judge, that the ſenſation of ſound is rather heightened than diminiſhed by the water in the mouth.

In order to explain the eighth experiment, which was made with a braſs or iron wire, two things, in particular, are to be remarked; firſt, that ſuch metal ſtrings or wires are a great deal firmer than wood, and conſequently require a greater degree of force, in order to vibrate, than is poſſible to be produced by the air in ſpeaking: Secondly, that their baſe of contact with the teeth is by much too ſmall, for them to communicate a ſufficient degree of motion to the whole range of bones reaching quite to the ear: And this is the very reaſon, that by laying hold on it with the teeth, the points of contact being encreaſed, the deaf perſon comes to have ſome degree of ſenſation.

The happy effects produced with the beer-glaſs, and the unſucceſsful attempts with the wine-glaſs, which was the ninth experiment, ſeem to depend, either on the greater compaſs of the former, or on ſome degree of compreſſion produced in the air ſpoken into it, which thereby communicates its vibratory motions and repercuſſions to the elaſtic glaſs, and by that means to the teeth and upper jawbone, though the lips interpoſe or lie between, as they acquire a greater degree of cloſeneſs in their texture, and greater ſuſceptibility to propagate ſound, by the greater degree of preſſion, made on them with the rim of the glaſs: Whereas, a leſs portion of air goes into the wine-glaſs, beſides, its compaſs is ſmaller, and the greater maſs of foot or ſtalk, diminiſhes the motion of the air, ſo as to prevent its communicating to the teeth a ſufficient pitch of vibration. And laſtly, the reaſon why, according to the tenth obſervation or experiment, the looſe teeth of the upper jaw rendered ſpeaking indiſtinct to the deaf perſon, is eaſily underſtood, when we reflect, that, in order to propagate a vibratory motion, a cloſer continuity of elaſtic parts is requiſite.

As the ſenſation, which is perceived in the act of hearing, produced by the methods of the ſecond order of the ſecond claſs, ſeems to be formed almoſt in the middle of the brain, backwards at the *medulla oblongata*, we may hence, according to anatomical grounds, judge, that the vibrations produced by ſound, put the auditory nerves in ſenſation, from the *os petroſum*, quite to their origin: And hence ariſes this practical propoſition, that the eaſy method we have been hitherto upon, to procure hearing to the deaf, is adapted to all perſons afflicted with deafneſs, be the other auditory organs injured how they may, provided the auditory nerves are not obſtructed, injured, or quite deſtroyed at their origin: For, this laſt is the only caſe, in which the preſent method is not applicable, and on ſuch melancholy objects all labour and pains are loſt.

FINIS.

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